Stray Creek Soils Effects Analysis

Leah Carter, Central Zone Soil Scientist

Regulatory Framework and Project Compliance

Clearwater National Forest Land and Resource Management Plan

The Clearwater National Forest Land and Resource Management Plan (Forest Plan) outlines goals, objectives, and standards for managing the soil resource on National Forest lands. Goals for the soil resource on the Clearwater National Forest are to maintain soil productivity and ensure that soil resources are not irreversibly damaged from Forest management activities (F. S. U.S. Department of Agriculture, 1987). Objectives (p. II-6, Item 9) pertain primarily to the maintenance and restoration of watersheds. Forest-wide Soil Standards (p. II-33, Item 11) are listed in Table 1 below, alongside a brief description of how the proposed project achieves compliance for each standard.

Table 1. Clearwater National Forest Plan Soil Resource Standards and Project Compliance

Forest Plan Soil Standard	Description	Project Compliance Achieved by:
a.	Manage activities on lands with ash caps such that bulk densities on at least 85 percent of the area remain at or below 0.9 gram/cubic centimeter.	The project has been designed to limit the extent of Detrimental Soil Disturbance (DSD) to no more than 15% of a project area following the completion of all project activities. Because compaction is a contributing factor to DSD, adhering to the 15% standard addresses this Forest Plan standard.
b.	Design resource management activities to maintain soil productivity and minimize erosion.	Project design features have been developed for this project based on a combination of monitoring results, scientific research, best management practices, and professional experience. These design features are intended specifically to maintain soil productivity and minimize erosion during and following project activities.
c.	The minimum coordinating requirements for projects on land types with high or very high mass stability or parent material erosion hazard ratings are: (1) The field verification of the mapped unit and predicted hazard rating. (2) Review road locations using a team consisting of an engineering geologist, hydrologist, soil scientist, and a silviculturist. Assess concerns and possible mitigation measures to determine if a geotechnical Investigation is needed. (3) After the "P" line has been located, stake mitigating road designs, using the original ID team members and road designer.	No temporary roads are planned in areas with high mass wasting potential risk. Roughly 0.35 miles of temporary road is proposed on a landtype that has been mapped as having high parent material erosion risk. All temporary roads will be scarified and recontoured following the completion of all project activities (see Project Design Features), thereby mitigating any long-term increases in subsurface erosion risk.
d.	Review silvicultural prescriptions and unit locations on land type 50 (old slumps) to determine whether vegetation removal (timber harvesting) may contribute to slope instability.	No harvest is planned to take place where land type 50 occurs.

e.	Give special attention to compacted glacial tills in the Powell area. When projects are proposed in areas where compacted tills are known to occur or suspected to occur, an intensive soil map will be prepared and ground verified. Mitigation measures should be applied that will assure that water tables will not be raised or that subsurface water will not be converted to surface flows. Measures will also be applied to assure that soil erosion and resulting lowering of soil productivity will not occur.	This standard does not apply to the project because it is outside the scope of the project. There are no compacted glacial tills present in the Stray Creek project area.

Management Areas

The Stray Creek Project falls within one Management Area (MA), E1. The Forest-wide Soil Standards apply to this management area, with no additional MA-related soil standards.

Forest Service Manual (FSM) 2500, Chapter 2550 – Soil Management and Northern Region (R1) Supplement

The FSM 2550 and the R1 Supplement provide direction for assessing, analyzing, and monitoring the soil resource on National Forest lands. Project development has been carried out to be consistent with both FSM 2550 and the R1 Supplement. The R1 Supplement also specifies that new activities must be designed such that they do not create detrimental soil conditions on more than 15 percent of an activity area, that "in areas where less than 15 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effect of the current activity following project implementation and restoration must not exceed 15 percent," and that "in areas where more than 15 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration should not exceed the conditions prior to the planned activity and should move toward a net improvement in soil quality" (U.S. Department of Agriculture, Forest Service, Northern Region, 2014). The Proposed Action complies with this standard. Table 3 displays the relevant detrimental soil disturbance data and calculations.

Federal and State Law

National Forest Management Act of 1976 (NFMA)

This act governs the planning of renewable resource management on National Forest lands to ensure that timber is "harvested from National Forest System lands only where soil, slope, or other watershed conditions will not be irreversibly damaged" and that timber harvest is "carried out in a manner consistent with the protection of soil … resources" (16 U.S.C. 1604 (g)(3)). Standards for the protection of the soil resource have been developed from this act and incorporated into the Forest Plan and the Forest Service Manual Region 1 Supplement. By conforming to these standards and applying the project design features associated with the project, the Proposed Action complies with NFMA.

Idaho Forest Practices Act of 1974 and Idaho Forestry Best Management Practices (BMPs)

The Idaho Forest Practices Act of 1974 ensures that the health of forest resources is maintained during the cultivation and harvest of forest trees in Idaho. The BMPs in the Idaho Forestry Best Management Practices Field Guide have been determined by the Idaho Department of Lands to be the most effective means of protecting forest resources during forest management activities (Barkley et al., 2015). This guidance has been incorporated into the project design features, thereby addressing the administrative rules laid out in the Idaho Forest Practices Act.

Approach to Analysis

Resource Indicators and Measures

Two resource elements, soil productivity and soil stability, have been developed as gauges of the soil's quality and ability to function. The status of these resource elements is evaluated by measuring specific resource indicators, as summarized in Table 2 below. These resource indicators are used in the soils analysis to efficiently assess the condition of the soil in its present state, the effects of proposed actions, compliance with regulatory standards, and the need for specific mitigation measures.

Soil Productivity

Soil productivity is defined by the Forest Service as "the inherent capacity of the soil resource to support appropriate site-specific biological resource management objectives, which includes the growth of specified plants, plant communities, or a sequence of plant communities to support multiple land uses" (U.S. Department of Agriculture, Forest Service, 2010). Detrimental Soil Disturbance (DSD) is a measure of visually-assessed soil attributes that give a snapshot of the soil's current condition and from which assumptions about soil productivity may be made (U.S. Department of Agriculture, Forest Service, Northern Region, 2014). The attributes visually assessed while conducting DSD surveys are:

- Forest floor attributes (ground cover, litter depth, amount of coarse woody debris)
- Surface soil attributes (topsoil displacement, erosion, ruts, puddled conditions, burn severity)
- Subsurface soil attributes (compaction, platy/massive structure)

Forest management activities can impact these soil attributes, resulting in DSD and the potential loss of soil productivity. The extent of detrimental disturbance caused by forest management activities is dependent on the activity, equipment used, method and season of operation, and silvicultural prescription (Clayton, 1990; Tepp, 2002).

Soil Stability

Soil stability is indicated by the extent of surface erosion (rills, gullies, pedestals, soil deposition) and mass wasting (e.g. landslides). Erosion and mass wasting are natural geomorphic processes, but they can be accelerated by human disturbances (Megahan, 1990). Forest management activities, especially timber harvest and construction of temporary roads, can impact soil stability by removing ground cover and displacing surface soils. When surface soils are moved downslope by erosion, loss of soil function can occur, as surface soils have a higher capacity to hold moisture and nutrients (and therefore support stabilizing plant and root growth) than subsurface soils. The Project Area has been mapped into landtypes, which are spatially grouped areas containing similar landforms, geology, soils, and vegetation (Winthers et al., 2005). Soil stability can be predicted by assessing the landtype of an area, as well as by looking for evidence of surface erosion and mass wasting in the field. Indicators of areas prone to mass wasting include: steep (over 60%) concave slopes; hydrophytic vegetation (i.e. sedges, moist site ferns); slumps, draws, and basins; past landslide locations; and obvious soil movement areas (typically indicated by curved and/or buttressed tree boles, soil creep, tension cracks, etc.).

Table 2. Resource Indicators and Measures for Assessing Effects

Resource Element	Resource Indicator	Measure	Source
Soil Productivity	Detrimental Soil Disturbance (DSD)	Percent DSD per Activity Area	Clearwater National Forest Plan, Region 1 Supplement

Resource Element	Resource Indicator	Measure	Source
Soil Stability	Soil Erosion	Acres of Proposed Harvest on Landtypes Rated with High or Very High Erosion/Mass Wasting Risk	Clearwater National Forest Plan, Region 1 Supplement
		Miles of Proposed Temporary Road on Landtypes Rated High or Very High for Erosion/Mass Wasting Risk	Clearwater National Forest Plan, Region 1 Supplement

Spatial and Temporal Context

The spatial boundary for the effects analysis is the 839-acre Stray Creek Project Area. The effects of Forest Management activities on soils is site-specific, and thus all direct, indirect, and cumulative effects will occur within the project area. The temporal boundary for shorter-term effects, such as increased erosion risk, is roughly 5 years following the completion of all project activities. For longer term effects such as compaction, the expected timeline of recovery is several decades (Powers et al., 2005).

Data Sources

LiDAR imagery, aerial imagery, GIS-generated reports and maps, and spatial analysis were used to analyze potential effects to soil productivity and soil stability resulting from past harvest activities and inherent soil characteristics. The proposed harvest units were surveyed to estimate the current spatial extent of Detrimental Soil Disturbance (DSD) in December 2019 using the Forest Soils Disturbance Monitoring Protocol (Page-Dumroese, Abbott, & Rice, 2009a, 2009b). Assumptions used for the calculations of DSD are based primarily on local research and monitoring results (Archer, 2008; Reeves, Page-Dumroese, & Coleman, 2011). These are summarized in the DSD Calculations Excel Workbook located in the Project Record. Areas with high potential erosional risk were evaluated through an erosion hazard assessment using mapped landtype properties. Mass wasting, surface erosion, and subsurface soil erosion potentials were evaluated for the landtypes coinciding within the proposed activity units.

Environmental Effects Analysis

Existing Condition

The soils in the Stray Creek project area are predominately loams derived from loess over gneiss, granite, and/or mica schist ("Web Soil Survey," n.d.). Mazama volcanic ash has a minor influence on the soils in the project area. When it overlays coarser-grained material such as soil derived from granite, volcanic ash increases the water-holding capacity of the soil, thereby increasing forest productivity (Barkley et al., 2015). Landforms in the project are mostly low relief rolling hills.

Past soil-disturbing activities in the project area include commercial timber harvest, precommercial thinning, fuel management activities, road management activities, and wildfire. The current detrimental soil disturbance resulting from past management activities is 0% in all proposed units (Table 3). The lack of visual disturbance to the forest floor and the presence of sufficient litter and coarse woody debris indicate that recovery of soil quality and function is underway following past disturbances.

Portions of the project area exist on mapped landtypes that have been rated as having high potential mass wasting, surface erosion, and/or subsurface erosion risk. The project has been designed to minimize ground-disturbing activities in these areas and to avoid harvest in field-verified landslide-prone areas.

No Action Alternative

Under this alternative, no vegetation management or road improvement activities would occur, and the existing condition would be maintained. Current levels of DSD would persist in the short term, with slight natural development of the soil surface layers over time due to the continued addition and decay of woody and herbaceous plant material. Current soil erosion and landslide risk would remain roughly the same in the short term, with some changes potentially occurring over time due to changes in climate patterns (Barik, Adam, Barber, & Muhunthan, 2017). In the occurrence of a high severity wildfire, soils may have increased erosion and landslide risk due to loss of stability provided by vegetative cover and may experience a drop in soil productivity due to the loss of topsoil. The No Action Alternative does not meet the Purpose and Need outlined in the project proposal.

Proposed Action

Those activities that are expected to have direct, indirect, and/or cumulative effects on the soil resource are: tractor harvest (approx. 114 acres), skyline harvest (approx. 287 acres), and temporary road/swing trail construction (approx. 3.1 miles). Site preparation activities (broadcast and/or jackpot burning, hand and/or mechanical piling, mastication of activity-generated fuels) are included in the calculations for the commercial harvest activities. Though permanent roads impact both soil productivity and soil stability, they are not considered in the soils analysis, as the evaluation of effects of permanent roads is most effectively done at the watershed scale (U.S. Department of Agriculture, Forest Service, Northern Region, 2014).

The project design features for this project are outlined in Table 1 of the Environmental Assessment for this project. These criteria have been developed from Forest Plan Standards and Guidelines, the Forest Service Manual 2500 and Region 1 Supplement, Idaho Forest Practices Act Rules, and Idaho Forestry Best Management Practices. Past monitoring and research indicate that the effectiveness of the project design criteria in offsetting impacts to soil productivity and soil stability would be moderate to high (Froehlich & McNabb, 1983; Graham et al., 1994; Korb, Johnson, & Covington, 2004).

Direct and Indirect Effects

Direct effects are effects that occur at the same time and place the action is implemented. Potential direct effects to the soil resource from timber harvest and associated temporary road/swing trail construction include compaction, rutting, puddled conditions, topsoil displacement, erosion, and loss of organic matter (including litter and coarse woody debris), all of which can negatively impact soil productivity. These effects are reflected by the estimated percentage increases in the extent of Detrimental Soil Disturbance in all project units (Table 3). The proposed project design criteria will assist in mitigating activity impacts to soil productivity. Specifically, restricting activities when soils are wet (SR-1), strategically locating skid trails (SR-3), restricting post-harvest equipment to previously impacted areas (SR-4), ensuring suspension of the leading end of the log in skyline yarding systems (SR-5), decommissioning skid trails, landings, and temporary roads (SR-7, SR-8, SR-9), keeping slash piles small (SR-10), and retaining coarse woody debris (SR-11) have been shown through research and monitoring to be effective means of minimizing DSD from timber harvesting activities. Additionally, less soil disturbance will occur in the skyline harvest units (Krag, Higginbotham, & Rothwell, 1986), which is the yarding method proposed for roughly 70% of the total activity acreage.

Direct effects to soil stability can result from the increased risk of mass movement and erosion following removal of topsoil and stabilizing vegetation on high-risk landtypes. Increases in the extent of ground-disturbing activities (harvest and temporary road/swing trail construction) on high-risk landtypes correlate with increased erosion and mass movement risk. The Proposed Action includes 78 acres of proposed harvest and less than half a mile of proposed temporary road on landtypes rated as having a high or very high erosion risk. Approximately 31 acres of skyline harvest is proposed on landtypes rated as high for mass wasting risk; however, the Proposed Action involves excluding field-verified landslide-prone areas from harvest, so sensitive areas will be excluded as they are found in the field. Approximately 47 acres of tractor harvest is proposed on an area that has been rated as high risk for subsurface erosion. Roughly a quarter mile of new temporary road would be built on a landtype rated as having high potential for subsurface erosion, with an additional 0.1 miles that is proposed on an existing road template. Certain project design features, such as restricting activities when soils are wet (SR-1), limiting the slope on which ground-based skidding is conducted (SR-2), constructing drainage controls and applying slash to corridors (SR-6), decommissioning skid trails, landings, and temporary roads (SR-7, SR-8, SR-9), and retaining coarse woody debris (SR-12), will serve to further decrease the risk of erosion and mass movement in the project area.

Indirect effects are effects that are spatially and/or temporally removed from the time and place in which the action is implemented. The primary indirect effect of the Proposed Action, resulting from the associated fuel reduction and management activities, would be a reduced potential for severe wildfire and the accompanying impacts on both soil productivity and soil stability.

Cumulative Effects

Cumulative impacts result from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions that overlap spatially and temporally with the Proposed Action. For the soil resource, cumulative effects occur within the same spatial and temporal boundaries as the direct and indirect effects. Past activities in the area that have impacted soil productivity and soil stability within the Project Area include timber harvest activities, precommercial thinning, fuel management activities, wildfire, and road management activities.

Fuel management activities (pile burning and creation of fuel breaks) and wildfire are the most recent disturbances to soil productivity, with fuel management occurring since the 1980s and the Woodrat Fire occurring in 2015. Timber harvest and precommercial thinning occurred in the proposed activity areas from 1965 to 1979. The field surveys for Detrimental Soil Disturbance done in December 2019 capture the residual effects of these past disturbances. This data shows that the soil has almost fully recovered within the 40-year period between the last commercial harvest and the present, and that the more recent fuel management activities and wildfire have had minimal impact on the soil (Table 3). Future fire suppression activities may occur within the project spatial and temporal boundaries, but, given the current extent of recovery in the area from similar past activities, these are not expected to have a significant effect on cumulative DSD.

There are no expected cumulative effects to soil stability in the short term, and effects are expected to be beneficial in the long term. Decommissioning of any temporary roads built on existing road templates will improve infiltration and erosion risk in these areas, which would remain compacted and more prone to erosion if no action were to be taken.

Table 3. Estimated Detrimental Soil Disturbance per Activity Area

Unit	Existing DSD (%)	Proposed Action New DSD (%)	Cumulative Effects DSD (%)
a	0	6	6
b	0	12	12
c	0	11	11
d	0	6	6

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